



RIVADA  
NETWORKS



# DELIVERING INNOVATION IN PUBLIC SAFETY COMMUNICATIONS

Strictly Private & Confidential



## Rivada Networks Overview

- **Rivada Networks** is a leading designer, integrator and operator of wireless, interoperable public safety communications networks. We provide advanced communications solutions to the public safety community at local, state and federal levels.
- Through our innovative public safety communications solutions, Rivada addresses the limitations of existing public safety networks through the use of cellular networks and commercial off-the-shelf technology. The Rivada offering is focused on delivering 4G voice, video and data through the latest in LTE infrastructure delivering state of the art capabilities to public safety users.
- The reliable, fully interoperable, and cost-effective alternative to building expensive dedicated infrastructure that Rivada offers gives users the ability to leverage advanced communications capability.
- Rivada's customers consist of a diverse range of federal, state, and local agencies including USNORTHCOM, the National Guard Bureau, DHS, multiple states, and various state and local agencies.



## Rivada's Approach and Why It Appeals to States

- Rivada will privately fund the network build-out without using a cent of tax-payers money.
- The network will be built to carrier grade standards and will be capable of providing 4G cellular services to the mass market
- Rivada will use the large amounts of excess capacity on the network to provide commercial service to paying customers.
- The network will become a net generator of funding and will provide a positive cash return to the state treasury.
- The Rivada approach frees up existing communications spend (typically tens of millions of dollars annually per state), which can be used elsewhere to reduce state deficits.

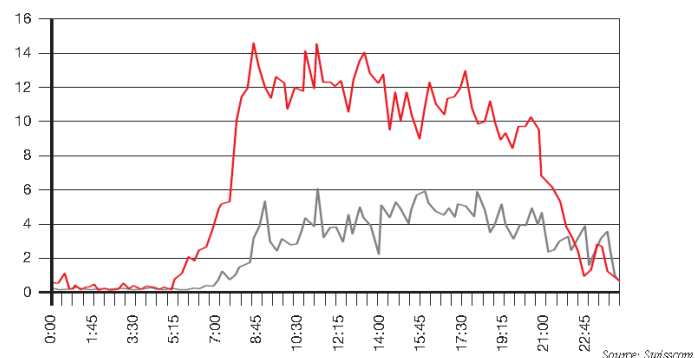


## Excess Network Capacity

- Traffic on cellular networks increases dramatically during incidents. During routine communications, public safety use is low and a large amount of the networks capacity goes unused.
- During an emergency, public service use spikes for the duration of the incident. This results from increased use of devices combined with an increase in the number of users as additional resources are called in to respond to the incident.
- Even during an incident, the increased traffic is usually limited to a number of cell sites in a particular geographic area, meaning the rest of the network is unaffected and will have excess capacity.

### Network Capacity - European Floods

*Call volume compared with a week earlier (single cell)*



### Network Congestion - Hurricane Katrina

*Daily Failed Calls (millions)*

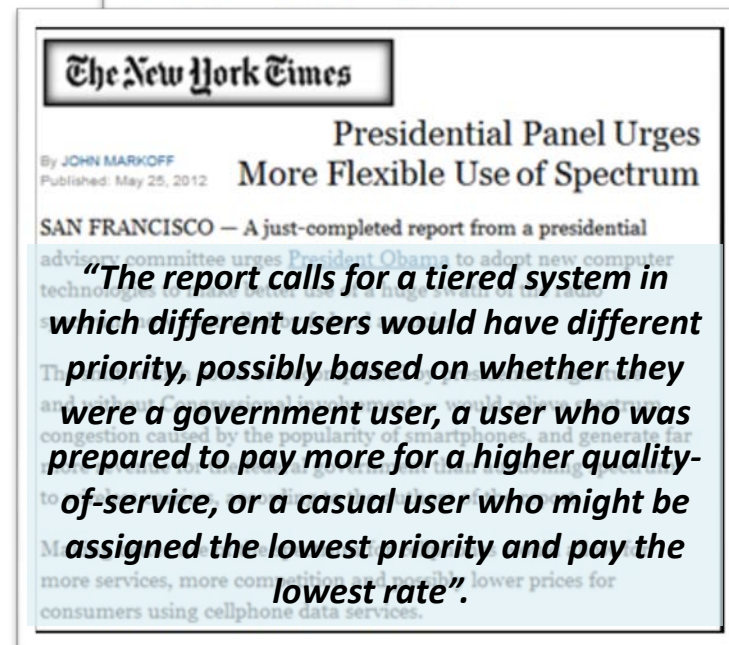






## Rivada's Patented Technology Model

- The technology approach allows FirstNet states/cities to maximize revenues on the network.
- Tiered Priority Access (TPA), allows the most efficient use of network resources by dynamically shifting network capacity to where it is most needed.
- The model provides true priority access per public safety requirement.
- Dynamic Spectrum Arbitrage (DSA), is a technology that allows more efficient provision of bandwidth to wholesale commercial customers while giving public safety complete control over the bandwidth 'throttle'.
- This general approach has been advocated by a recent Presidential Panel.
- Rivada was recently asked to provide testimony on this approach to a Congressional Hearing





# How the Approach Works

## Priority tiers

Mission critical access

Mission critical access

12 star

11 star

10 star

8 star

7 star

6 star

5 star

4 star

3 star

2 star

1 star

12 star

11 star

10 star

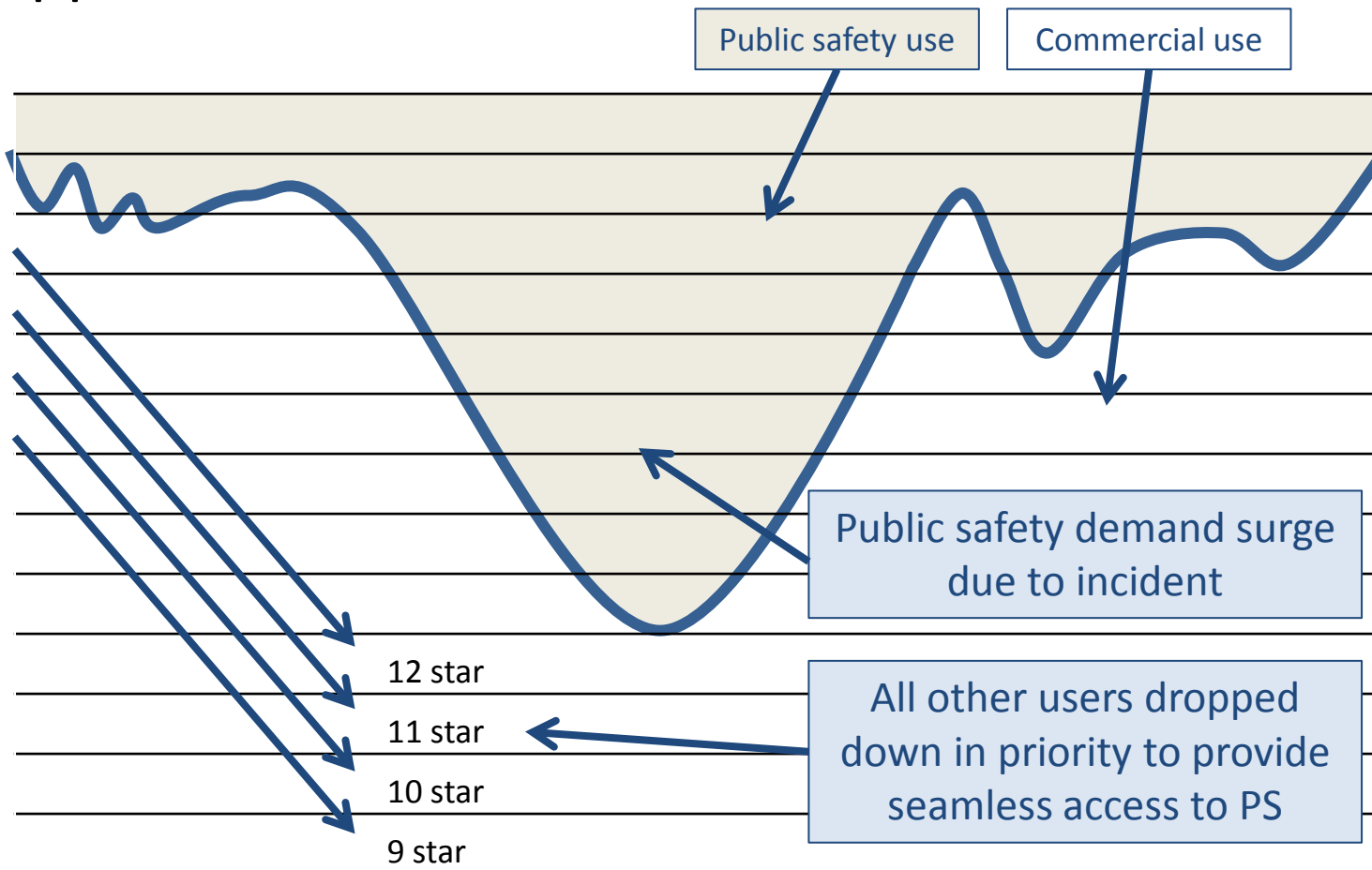
9 star

Public safety use

Commercial use

Public safety demand surge due to incident

All other users dropped down in priority to provide seamless access to PS





## Dynamic Spectrum Arbitrage -Tiered Priority Access (DSATPA) Overview

- Dynamic Spectrum Arbitrage -Tiered Priority Access (DSATPA) delivers and allocates public safety spectrum to users dynamically.
- Guarantees preemptive priority for public safety.
- The spectrum arbitrage capability enables dynamic arbitrage of the network to allow non-priority commercial access to the available spectrum which is underutilized by public-safety owners.
- Generates revenue for the public safety network.
- DSATPA delivers a capability to manage any frequency band based on pre-established usage rules.
- DSATPA permits the spectrum controller to charge for bandwidth making spectrum usage far more efficient.
- DSATPA is a feature set residing outside the LTE core. It is standards compliant.



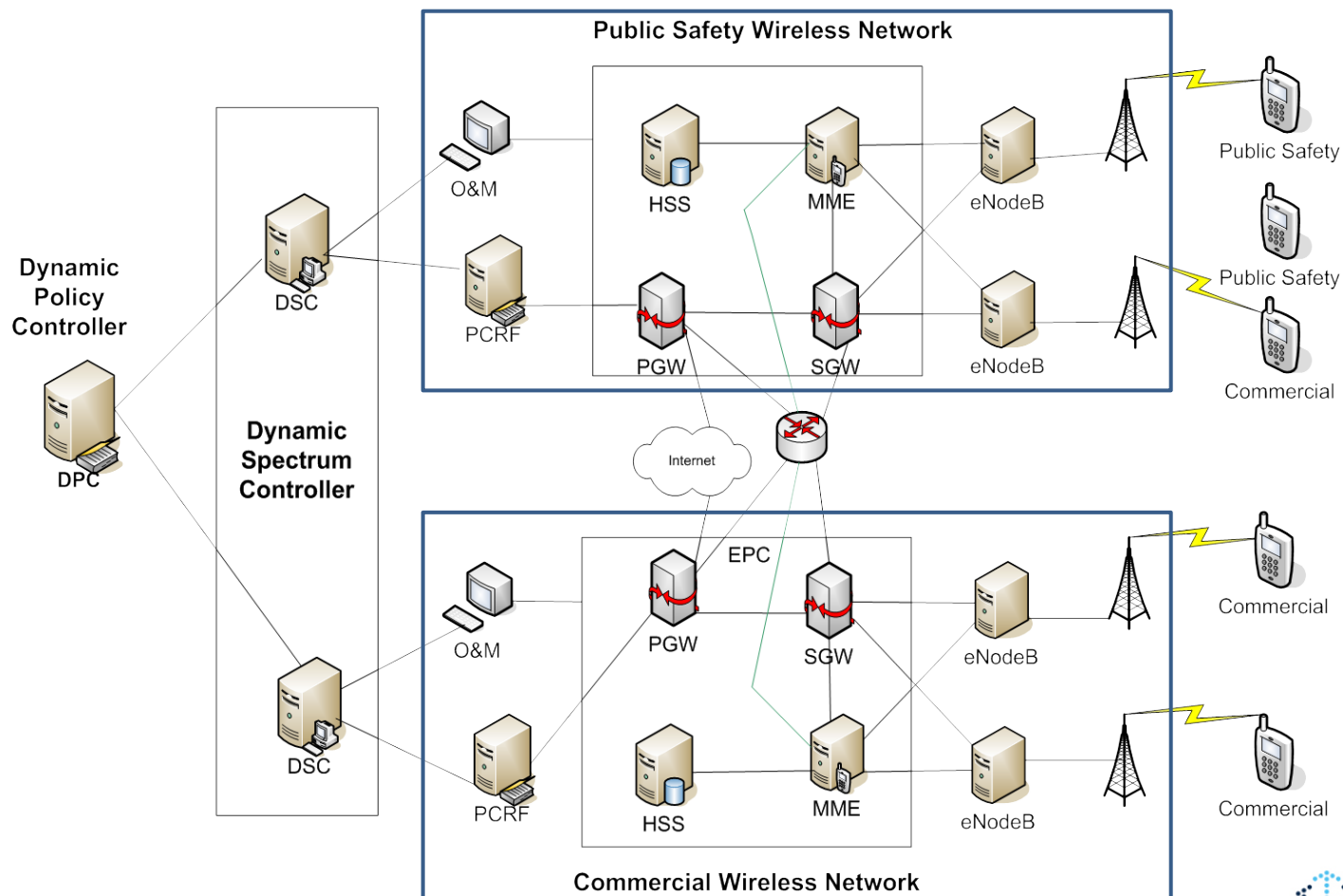
## Dynamic Spectrum Arbitrage

- The technology enables public safety to dynamically lease our radio spectrum to the highest competitive bidder, while retaining complete control of our network and the ability to instantly take spectrum back as and when the need arises.
- Public safety retains the ability to pre-empt spectrum as needed.
- The approach presents a win-win opportunity for spectrum holders and spectrum users.
- The competitive nature of this approach levels the playing field and means that we do not have to pick winners from amongst large versus small carriers and others, e.g. utilities.
- DSA technology unlocks the potential for supply and demand economics to bolster the quality, quantity and coverage of wireless broadband services.





# Network Architecture





# Rivada's User Interface – Spectrum Auction Process

Firefox | IBM Rational ClearQuest-7.0.0/ccpu | Rivada Networks | Total Interoperability | localhost / 127.0.0.1 / rprototype / gri... | localhost/DemoWebGui/client/lessor/add

**RIVADA NETWORKS**

Public Safety

- Dashboard
- Manage
- New Auction

## Add Resource Listing

This area allows you to create a new bandwidth lease auction.

**Public Safety Network**

Grid: Grid 1

**Lease Period**

Start Time

Start Date

End Time

End Date

**Bandwidth**

Quantity

Bandwidth Type

**Cost**

Minimum Bid

Buy Price

**Add Resource Listing**



## Demonstration Capability

- Rivada is in the process of demonstrating this capability major US states and cities.
- The prototype demonstrates a live working model of DSA and TPA on a stand-alone private network using LTE Band 14 network infrastructure and devices (smartphones, laptops, cameras, etc).
- The prototype also demonstrates dynamic roaming between the public safety network and the commercial network.

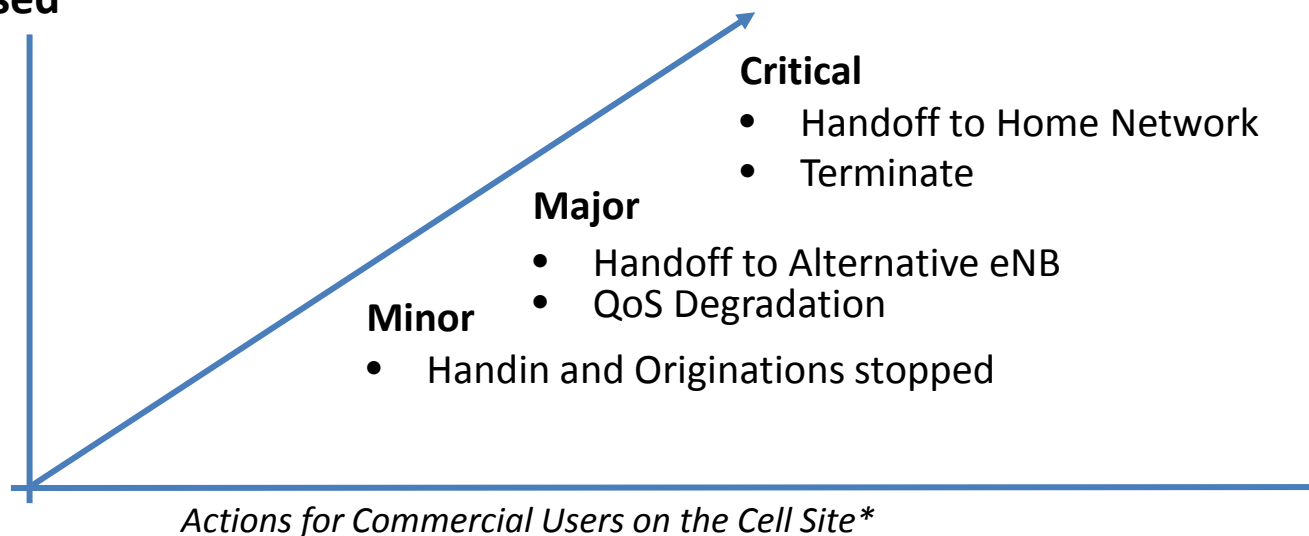




# Backoff Triggers

% capacity used

- 90%
- 70%
- 50%



- Designed to ensure resources are available for Public Safety when needed
- No manual intervention required (automatic)
- Implemented on an individual eNodeB basis
- 3 Alarm conditions (which are user definable)

*\*Public safety users not affected*